

PM_{2.5} Exceptional Event Supporting Documentation for 2007 Flagged Data

Purpose and request for concurrence

The purpose of this document is to provide technical evidence of data impacted by exception events, as defined in 40 CFR Parts 50 and 51, and to request that the United States Environmental Protection Agency (USEPA) concur with the South Carolina Department of Health and Environmental Control's (Department) findings and exclude data listed in Table 1 from future regulatory decisions.

Table 1: South Carolina 2007 PM _{2.5} concentrations requested for exclusion from future regulatory decisions.			
Date	Site ID	Site Name	PM2.5 Value
3/13/2007	45-037-0001	Trenton	36.0
5/3/2007	45-079-0019	Bates	39.2
5/3/2007	45-025-0001	Chesterfield	41.0
5/3/2007	45-041-0002	Sneed	42.2
5/3/2007	45-079-0007	Parklane	35.5
8/6/2007	45-019-0048	Charleston FAA	51.2
8/6/2007	45-019-0049	Charleston CPW	36.7
8/7/2007	45-019-0048	Charleston FAA	44.1
8/7/2007	45-019-0049	Charleston CPW	44.8
8/7/2007	45-013-0007	Beaufort	41.2
8/7/2007	45-051-0002	Myrtle Beach	46.7
8/8/2007	45-019-0048	Charleston FAA	40.5
8/8/2007	45-019-0049	Charleston CPW	35.6
8/8/2007	45-079-0019	Bates	36.9

Table 1: South Carolina 2007 PM _{2.5} concentrations requested for exclusion from future regulatory decisions.			
8/9/2007	45-063-0008	Irmo	35.1
8/9/2007	45-079-0019	Bates	36.8
12/11/2007	45-051-0002	Myrtle Beach	44.0

Event #1: March 13, 2007 - Trenton PM_{2.5}

The Department flagged measurements taken on March 13, 2007, at the Trenton monitor (45-037-0001) for PM_{2.5} because it believes the elevated PM_{2.5} concentrations were associated with smoke from a fire that occurred on the same day in Edgefield County. An exceedance of the PM_{2.5} standard occurred at the Trenton monitor with an average twenty-four hour PM_{2.5} concentration of 36µg/m³.

The Trenton monitor, located in Edgefield County, is approximately 30 kilometers downwind of the March 13, 2007 fire location. Map 1 indicates the area of observed smoke, originating near the McCormick and Edgefield County line and moving eastward towards the central portion of South Carolina passing directly over the Trenton monitor site.

A wind rose (Figure 1) was created for Edgefield County by using the Augusta National Weather Service Office wind data. This Augusta wind rose, representing Edgefield County area, indicates very little wind during the sample period. Over eighty-five percent of the hours on the day of the exceedance were reported as having calm winds. The low wind speeds contributed to higher smoke concentrations, but were not part of a region wide stagnation. Continuous monitoring collocated with the Federal Reference Method (FRM) (Figure 2) indicates the most significant plume impact actually occurred on the afternoon of March 12, 2007, with elevated PM_{2.5} levels continuing through midday March 14, 2007.

Map 1: Smoke Plume in Edgefield County on March 13, 2007

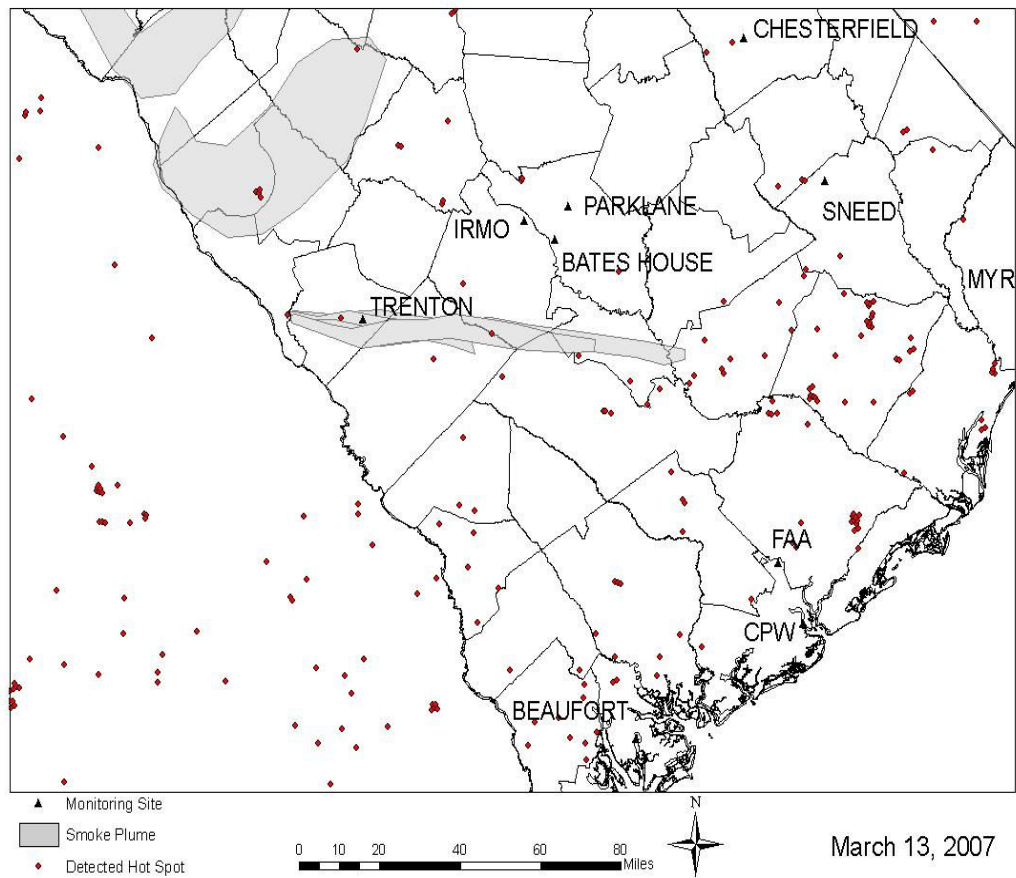
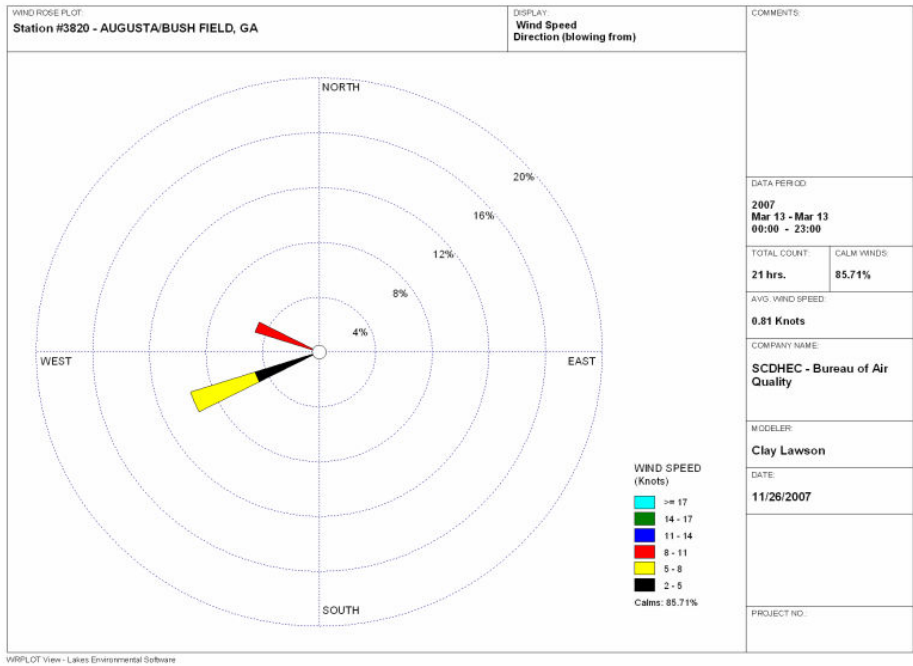
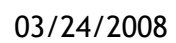


Figure 1: Wind Rose from the Augusta National Weather Service Office for March 13, 2007



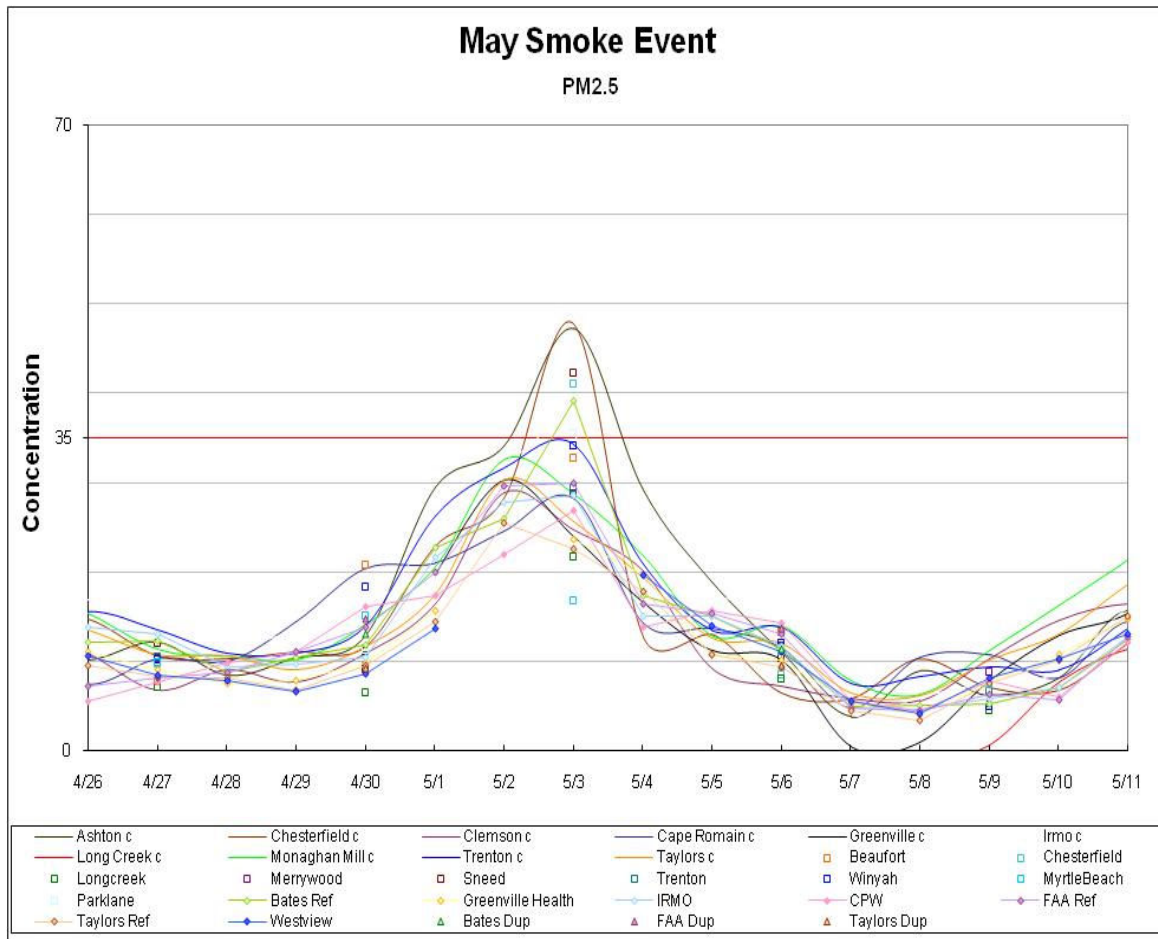
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Event #2: May 3, 2007 - Central and Northeastern SC PM_{2.5}

Smoke associated with the Turnaround and Bugaboo wildfires burning across southern Georgia and northern Florida caused elevated PM_{2.5} concentrations across the Midlands and Pee Dee sections of the state in the first week of May 2007 and significantly contributed to exceedances of the twenty-four hour standard at four monitors in South Carolina (Figure 2). On May 3, 2007, exceedances were measured in Columbia (Bates (45-079-0019) - 39.2µg/m³ and Parklane (45-079-0007) - 35.5µg/m³), Florence (Sneed (45-041-0002) - 42.2µg/m³) and in rural Chesterfield County (Chesterfield (45-025-0001) - 41µg/m³).

Figure 3: Statewide PM_{2.5} concentrations during the May smoke event



During the week-long event, smoke was transported northeastward across much of central and eastern South Carolina. Map 2 indicates that smoke was detected across most of central and eastern South Carolina on May 2, 2007. Map 3 indicates a continuation of the smoke impact across southern and eastern portions of the state on May 3, 2007.

Wind roses were created for the central and northeastern portions of the state, since this was the area where the monitors showed exceedances of the standard. Wind data from the National Weather Service Office in Columbia was used to represent the

central portion of SC (Figures 4 and 5). Wind data from the ASOS station in Florence was used to represent the northeastern portion of the state (Figures 6 and 7). The wind roses for May 2, 2007, showed a southwesterly wind direction dominating across the central portion of South Carolina with a south-southwesterly wind direction (Figure 4 and Figure 6) dominating across the northeastern part of South Carolina. The wind pattern contributed to the transport of smoke from the area of the Georgia and Florida wildfires northeastward into central and eastern South Carolina. On the following day, winds were more variable, due to a possible frontal passage, causing the winds to shift from the southwest to northeast as it progressed from the northeastern to the southwestern part of the state.

The May 3, 2007, Columbia (Figure 5) and Florence wind rose (Figure 7) indicated a southwesterly wind direction dominated until late. During the late afternoon, the winds shifted to a northeasterly direction, indicating a possible frontal passage and coincident with the reduction of smoke impact.

Map 2: May 2, 2007 Smoke Plume Map- Impact of Georgia and Florida Fires

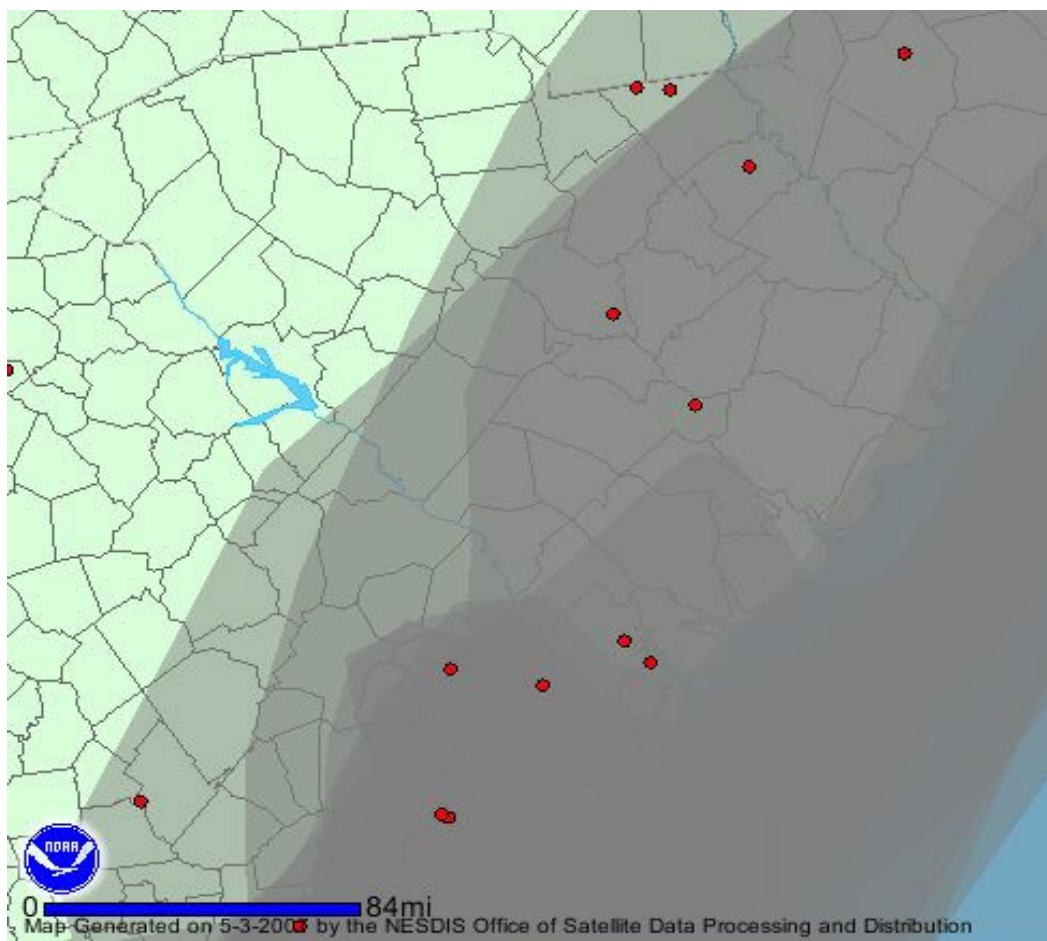


Figure 4: Wind Rose from the Columbia National Weather Service Office for May 2, 2007

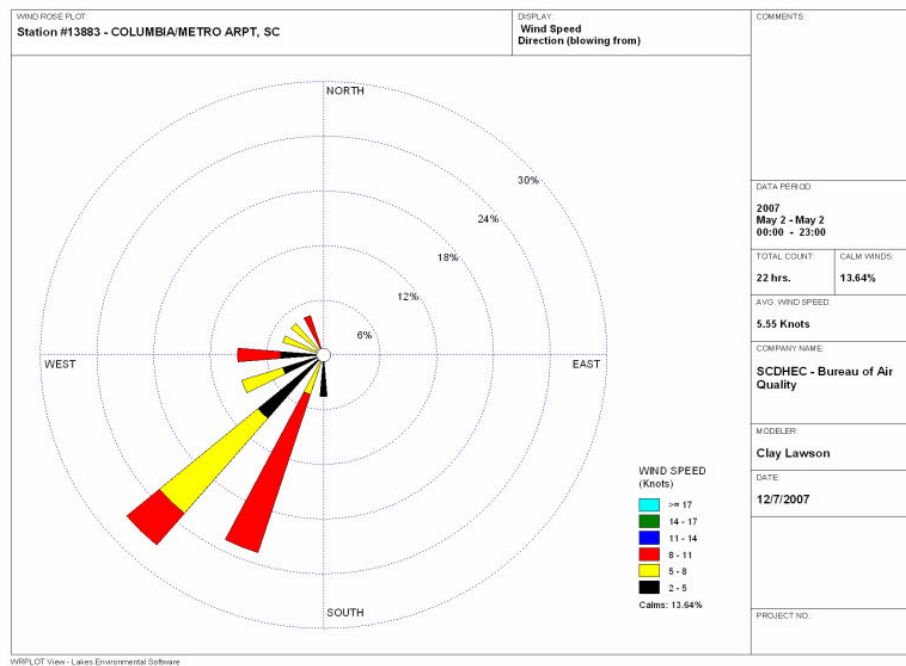


Figure 5: Wind Rose from the Columbia National Weather Service Office for May 3, 2007

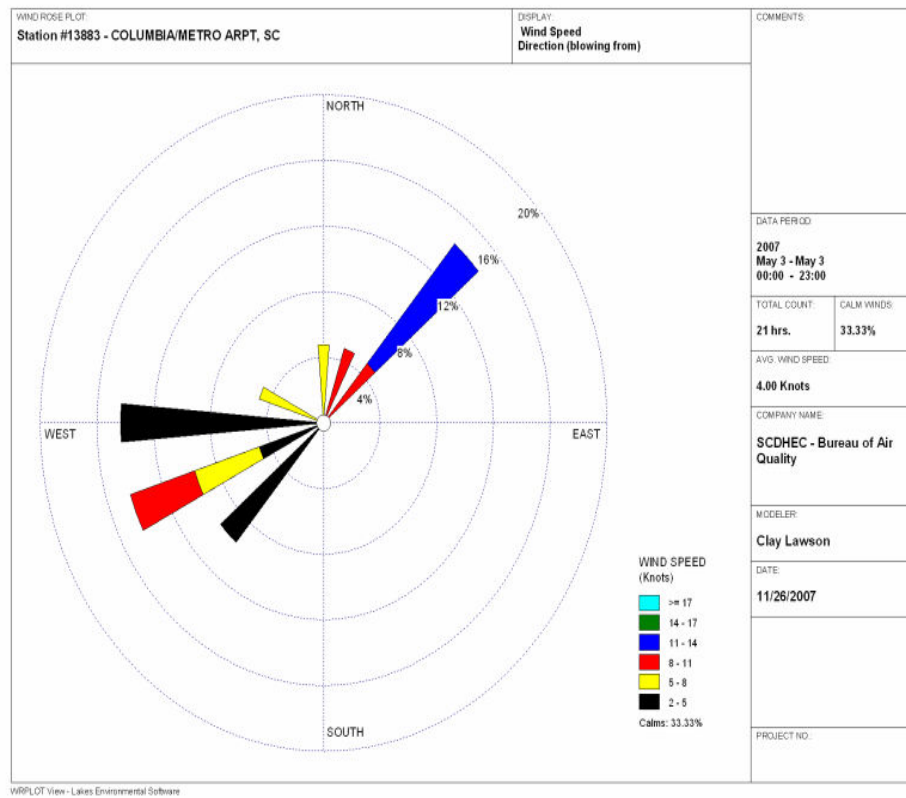


Figure 6: Wind Rose from the Florence ASOS station at the airport for May 2, 2007

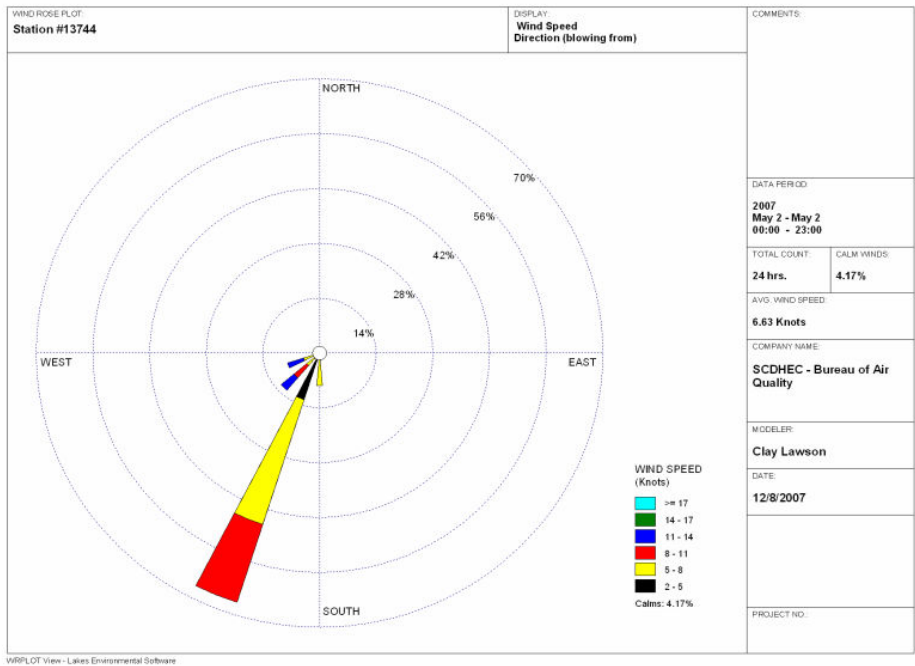
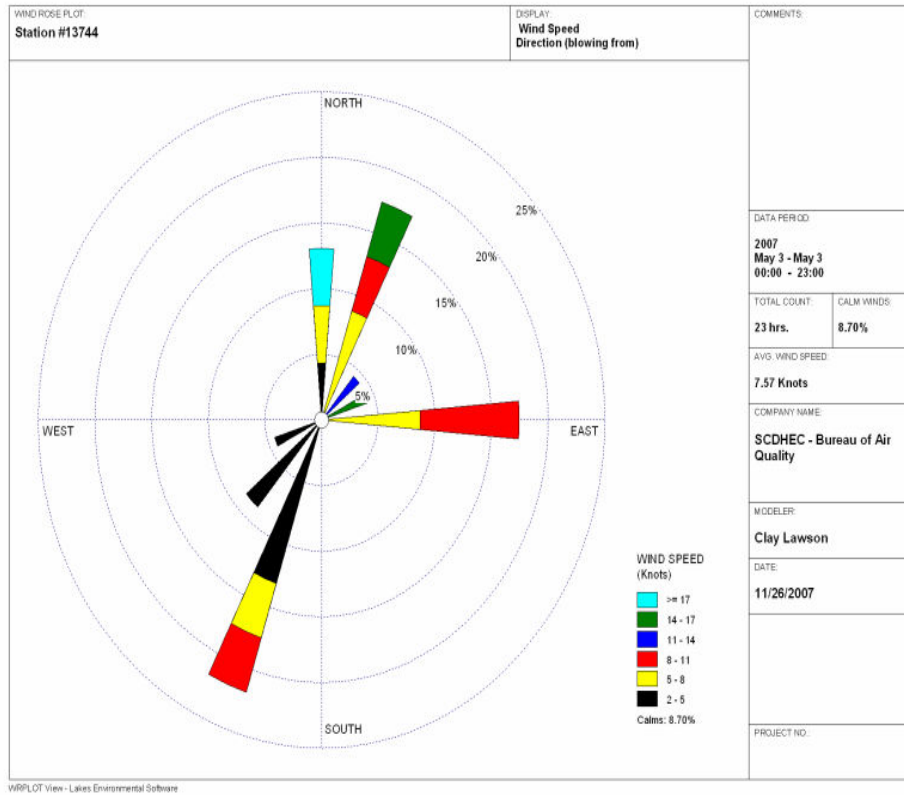


Figure 7: Wind Rose for the Florence ASOS station at the airport for May 3, 2007



Event #3: May 17, 2007 - Charleston Public Works (CPW) PM_{2.5}

On May 17, 2007, a twenty-four hour average PM_{2.5} concentration of 71.5 µg/m³ (Figure 8) was recorded at the CPW site (45-019-0049). This was the only twenty-four hour PM_{2.5} exceedance that occurred in South Carolina on this day and was significantly higher than any other measured concentration in the state. The Charleston PM_{2.5} monitored concentrations showed an apparent decreasing impact with distance from the CPW site. PM₁₀ monitoring data in the Charleston area also indicated atypical particulate concentrations (Figure 9). The event appeared to have been localized and unusual in location. After additional investigation into this event, the Department concluded that there was not enough evidence to support this as an exceptional event. For this reason, the Department is not seeking concurrence for this event.

Figure 8: PM_{2.5} Concentrations during the May 17, 2007 event

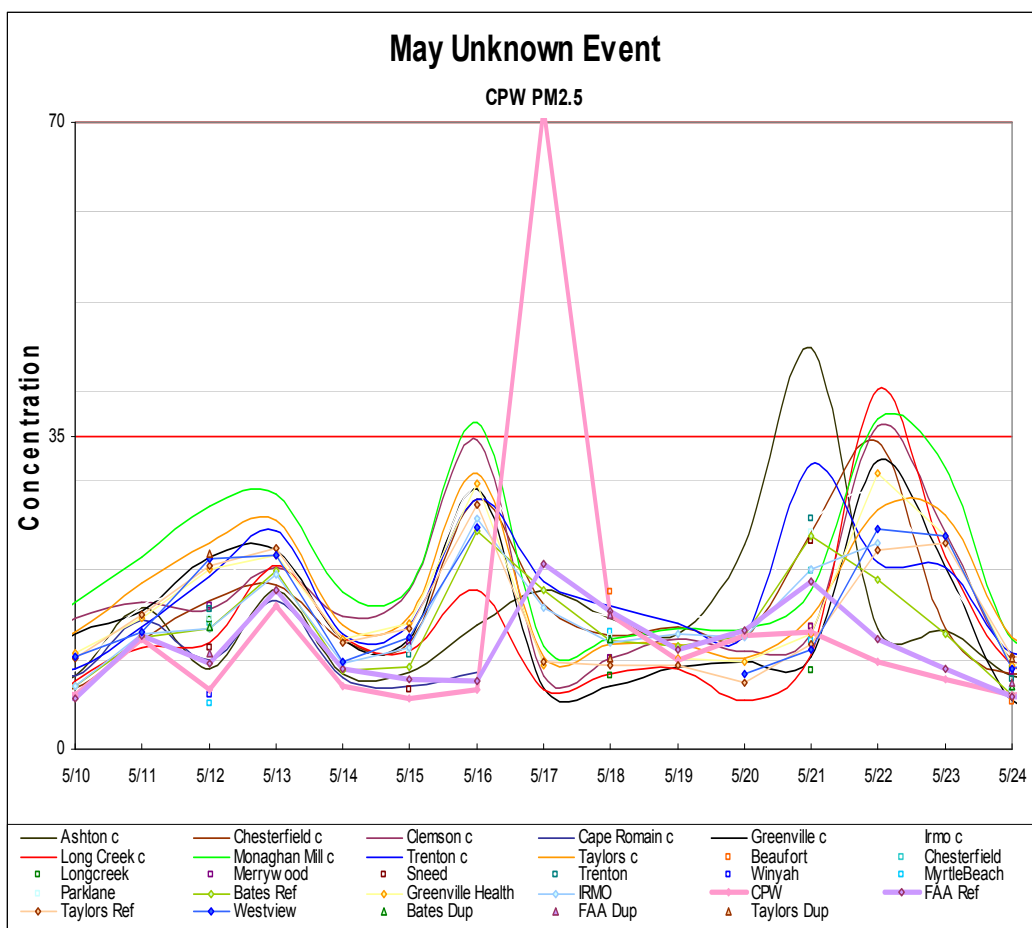
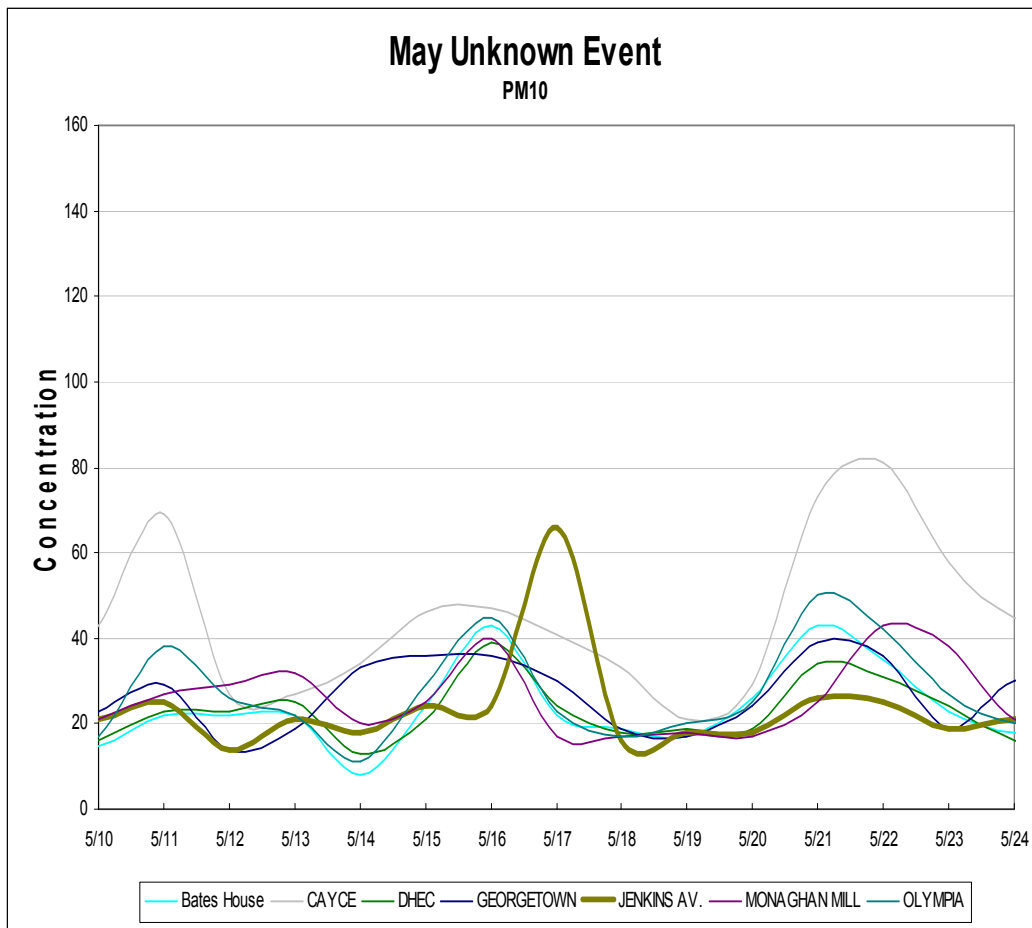


Figure 9: PM₁₀ concentrations during May 17, 2007 event



Event #4: August 6-9, 2007 PM_{2.5}

During early August 2007, particulate concentrations throughout South Carolina were impacted by smoke originating from wildfires burning in Idaho, Montana, Oklahoma, and Kansas. The smoke substantially contributed to eleven measured exceedances of the twenty-four hour PM_{2.5} standard (Figure 10). Speciation Trends Network (STN) protocol sampling and analysis indicated smoke impacts at all sampling locations during the period (Figure 11).

Figure 10: PM_{2.5} concentrations during the August 6-9, 2007, smoke event

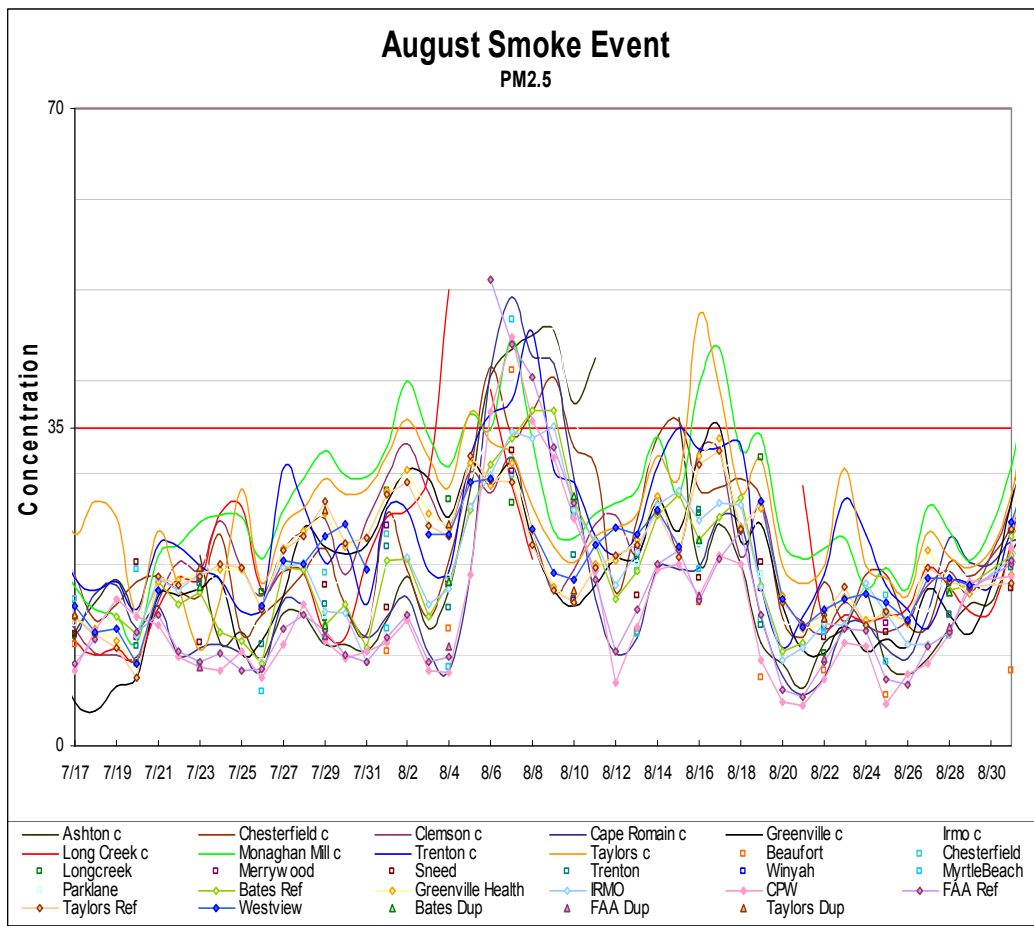
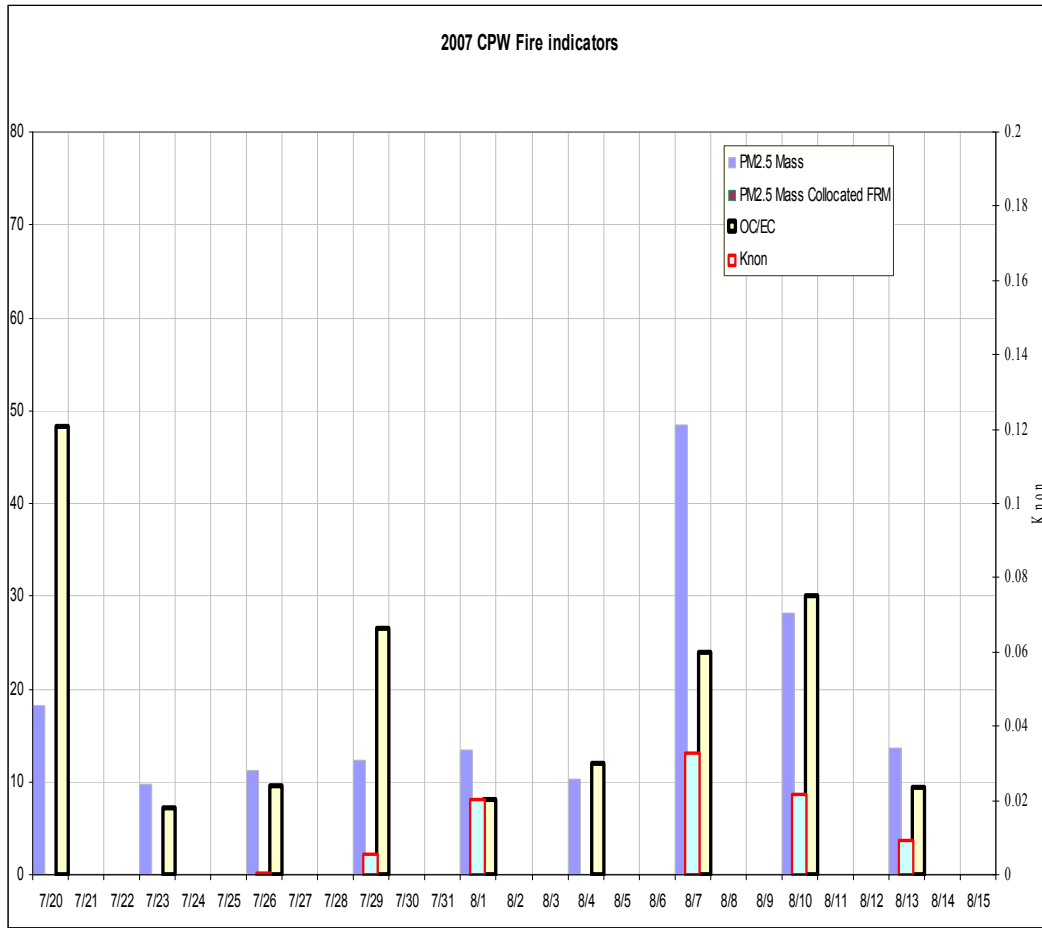


Figure 11: Fire Indicators from STN protocol sampler in the Charleston area



Event #4A: August 6, 2007 - Charleston area PM_{2.5}

Wildfires burning in Idaho, Montana, Oklahoma, and Kansas significantly contributed to two exceedances of the twenty-four hour PM_{2.5} standard in the state of South Carolina on August 6, 2007. Both measurements were made in the Charleston area samplers, CPW (45-019-0049), recording 36.7 µg/m³ and Federal Aviation Administration (FAA) (45-019-0048) recording 51.2 µg/m³.

Smoke plume maps and back trajectories indicated that these exceedances were related to a large area of smoke indicated on smoke plume maps for August 6 and 7, 2007, which were associated with fires in the western United States (Map 3). These maps indicate several major smoke plumes, originating near Montana and Idaho, spreading southward and eastward across most of the Eastern United States. As seen on these maps, smoke covered the entire state of South Carolina on August 6 and 7, 2007. Ground level impact is indicated by concurrent increases in particulate concentrations measured statewide in samplers and by continuous monitors.

Ninety-six hour back trajectories (Figure 12) were initialized at three different heights, starting at 8:00 PM on August 7, 2007, near the Charleston sites. The back trajectories from the Charleston area site indicated air was transported from the Mid-West and Tennessee Valley, southeastward into Coastal South Carolina. In addition, the back trajectories indicate smoke from the higher levels was likely mixed downward towards the surface as it was transported southeastward into Coastal South Carolina. The Department believes that the transport of smoke from the western wild fires into South Carolina occurred over a period of several days and was responsible for the PM_{2.5} exceedances at both Charleston sites.

Map 3: Smoke Plumes from Idaho and Montana Wildfires on August 6, 2007

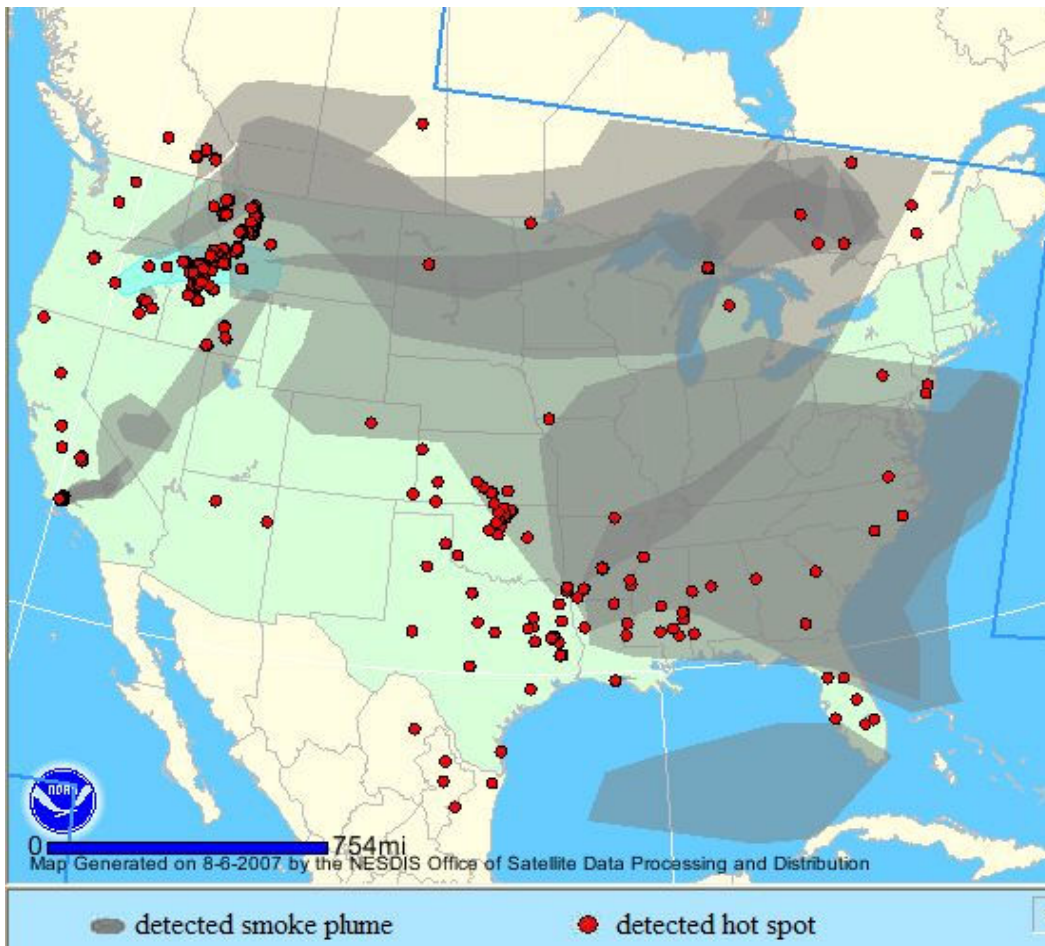
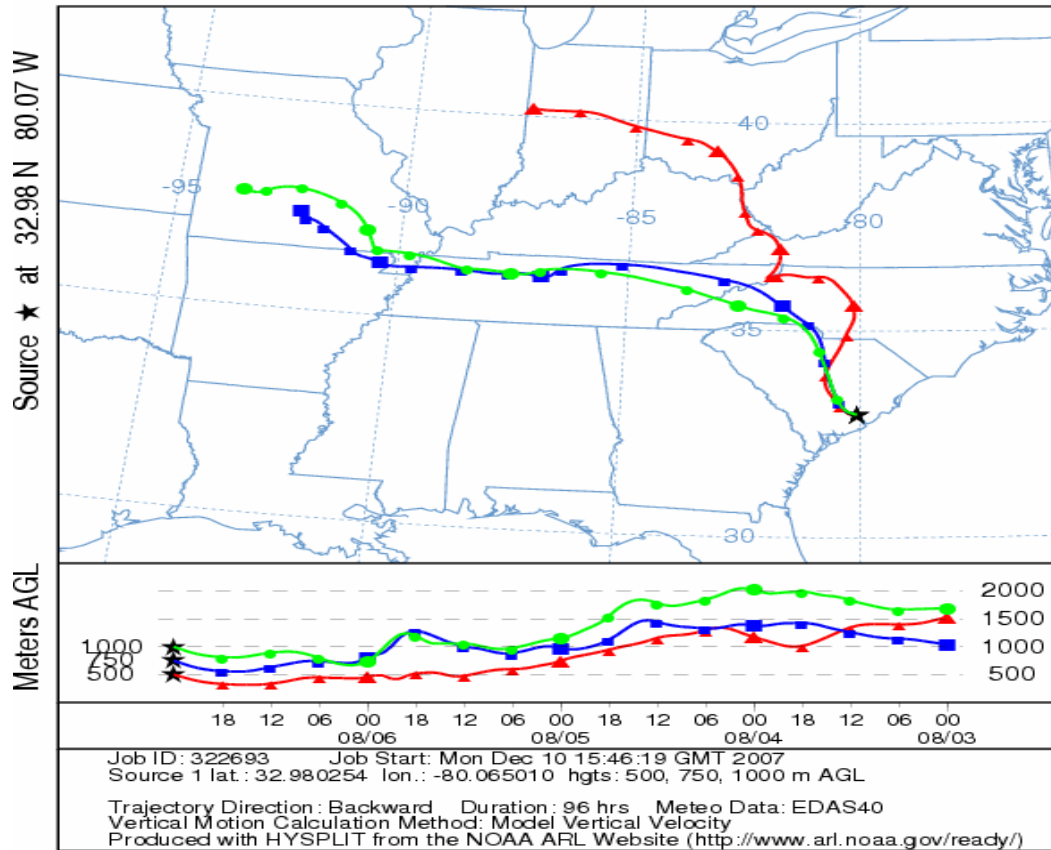


Figure 12: Back trajectories for the CPW site on August 6, 2007

NOAA HYSPLIT MODEL
Backward trajectories ending at 00 UTC 07 Aug 07
EDAS Meteorological Data



Event #4B: August 7, 2007 - Coastal area PM_{2.5}

The impact of the wildfires in Montana and Idaho continued on August 7, 2007, a sampling day on the one-in-three schedule. More samplers were operating and exceedances of the twenty-four hour PM_{2.5} standard were measured at four monitors along the South Carolina coast. The Charleston area samplers, CPW and FAA, recorded 44.8µg/m³ and 44.1µg/m³, respectively. The Beaufort King Street site (45-013-0007) twenty-four hour concentration was 41.2µg/m³ and the Myrtle Beach site (45-051-0002) twenty-four hour concentration was 46.7µg/m³.

Map 4 indicates a significant amount of smoke transport from the Idaho and Montana wildfires towards the East coast of the United States. Once the smoke had reached East coast, the map indicates the smoke plume traveled southward into the Southeast United States.

A set of three trajectories for each of the four monitors were run backwards for several days starting at 8:00 PM on the day of the exceedance. The back trajectories from the Charleston and Beaufort sites (Figure 13 and Figure 14) indicated a general transport direction from the west-northwest to the east-southeast into the Tennessee Valley area. The trajectories then indicated air movement from west-northwestward to east-southeastward across the Tennessee Valley and into the southern Appalachians. At this point, there was transport from the northwest to southeast across the southern Appalachians and continuing southeastward into the Upstate and central portions of South Carolina. The trajectory arrives at the Charleston and Beaufort areas at 8:00 PM on August 7, 2007.

The 2000 meter back trajectory at Myrtle Beach (Figure 15) shows air parcels moving into the lower Ohio River Valley from the west-northwest. At this point, the 2000 meter trajectory indicates air movement from the northwest to the southeast, across the remainder of the lower Ohio River Valley. Once moving past the lower Ohio River Valley, the trajectory indicates a southeastward movement of air parcels across portions of North Carolina, finally arriving at the Myrtle Beach area around 8:00 PM on August 7, 2007. The two lower level back trajectories indicate air movement from the Tennessee Valley area, east-southeastward across northern South Carolina and southern North Carolina, arriving at Myrtle Beach at 8:00 PM on the August 7, 2007.

Map 4: Smoke Plume from the Idaho and Montana fires on August 7, 2007

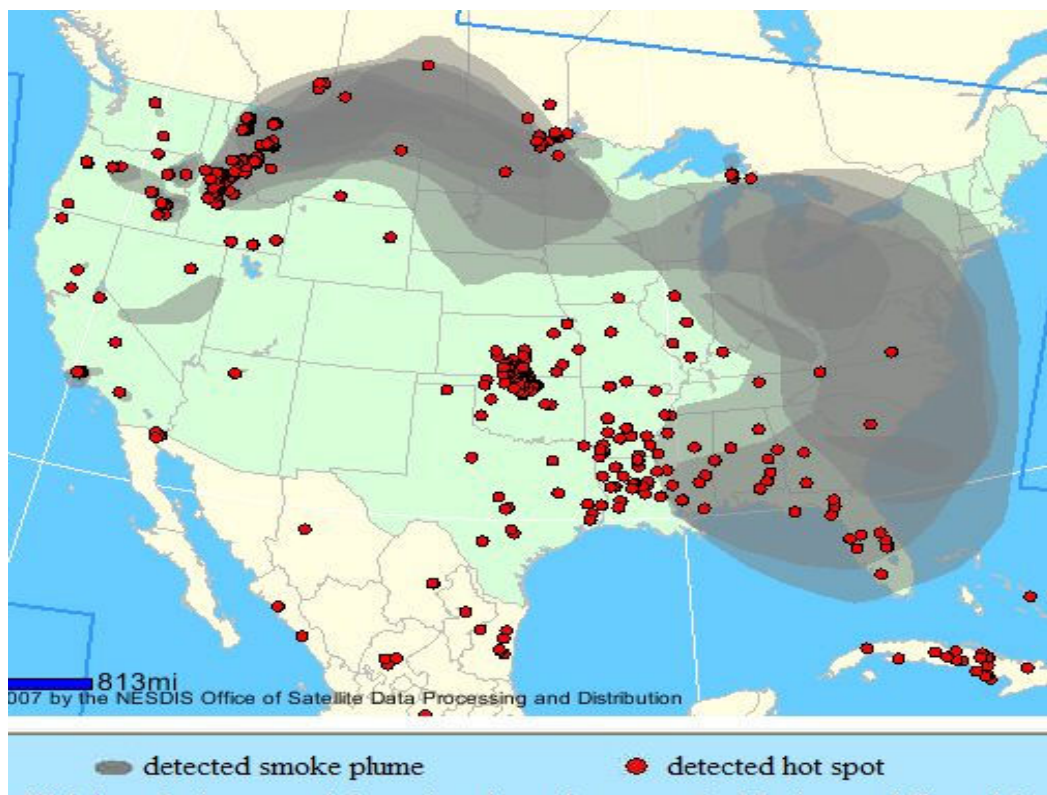


Figure 13: Back trajectories at Charleston on August 7, 2007

NOAA HYSPLIT MODEL
Backward trajectories ending at 00 UTC 08 Aug 07
EDAS Meteorological Data

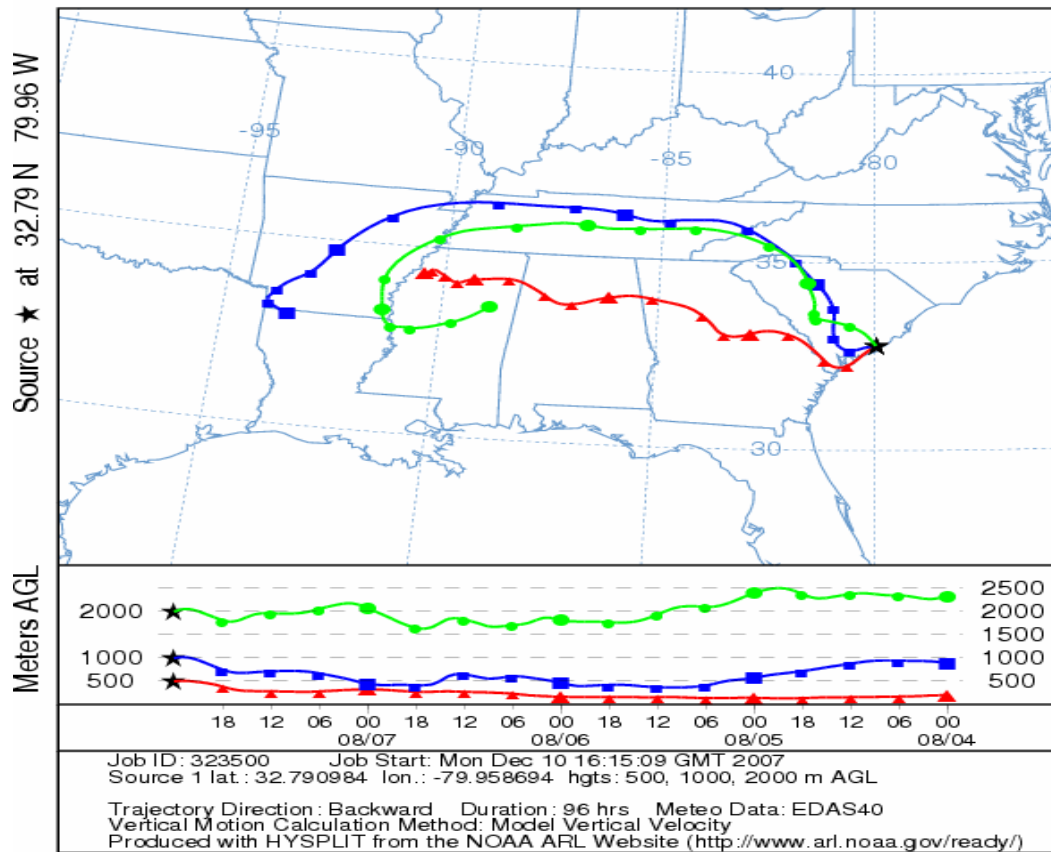


Figure 14: Back trajectories at Beaufort on August 7, 2007

NOAA HYSPLIT MODEL
Backward trajectories ending at 00 UTC 08 Aug 07
EDAS Meteorological Data

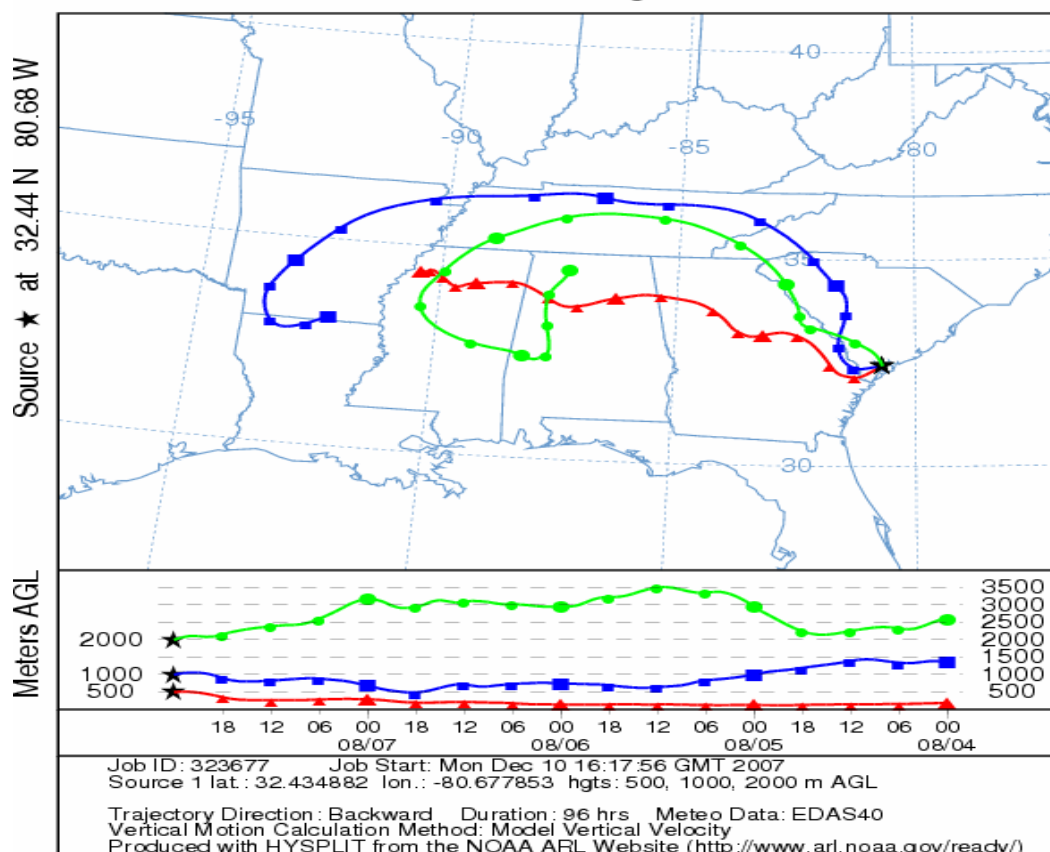
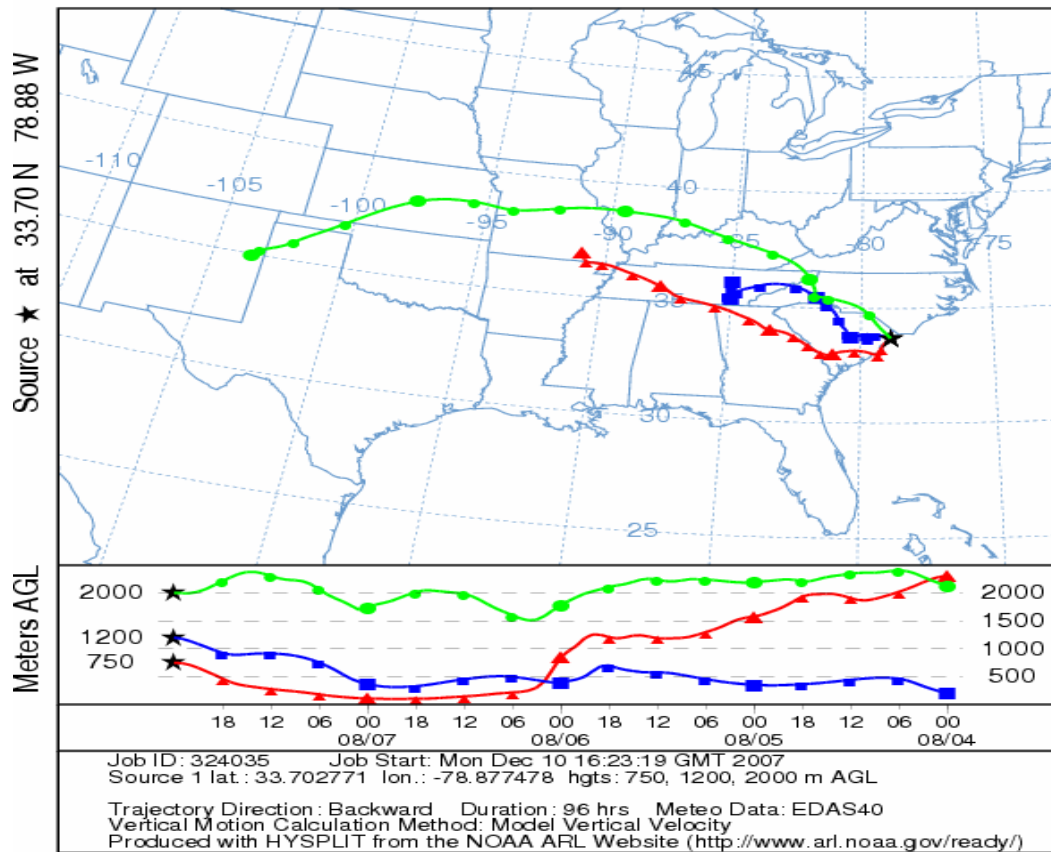


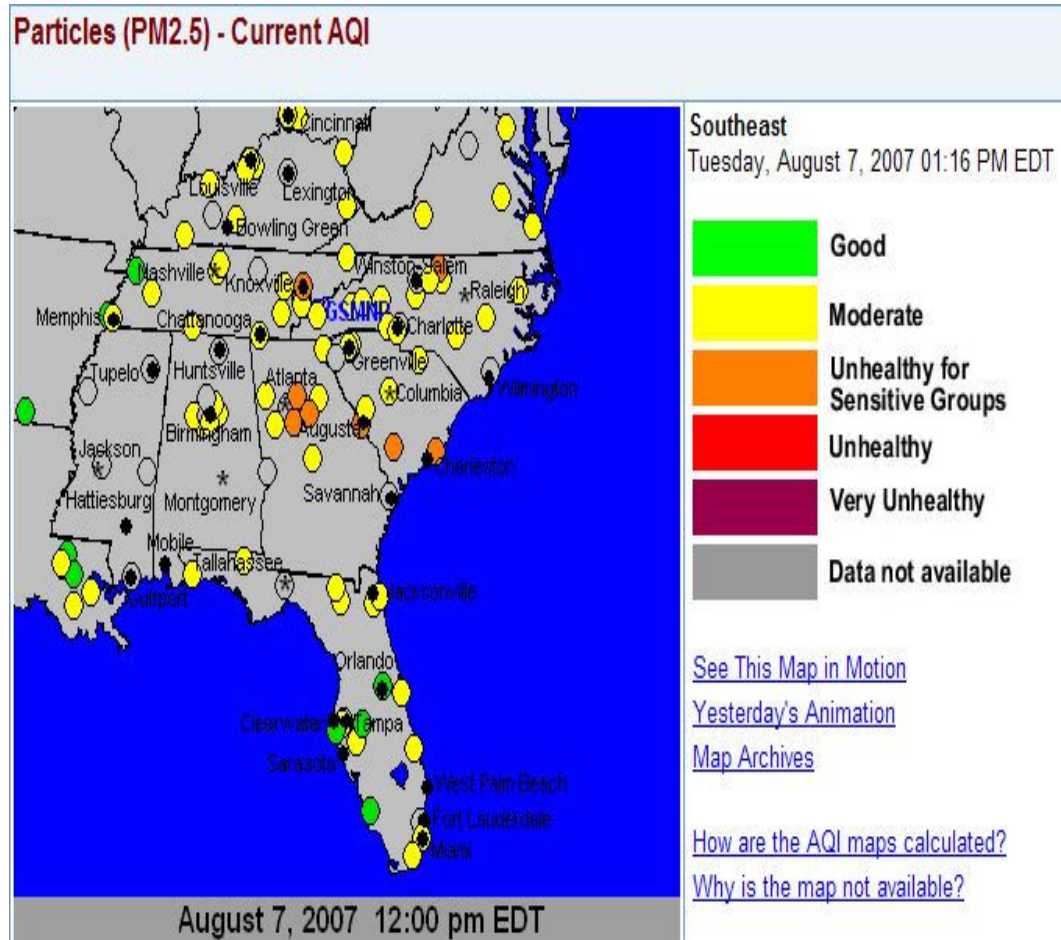
Figure 15: Back trajectories at Myrtle Beach on August 7, 2007

NOAA HYSPLIT MODEL
Backward trajectories ending at 00 UTC 08 Aug 07
EDAS Meteorological Data



As shown in AQI map (Map 5), elevated hourly $PM_{2.5}$ levels were reported at several sites around the state just after 1:00 PM on August 7, 2007.

Map 5: AQI map showing elevated $PM_{2.5}$ concentrations across southern and eastern South Carolina



Event #4C: August 8, 2007 - Charleston area PM_{2.5}

The peak period of the western fire impact continued into August 8, 2007, substantially contributing to three exceedances of the twenty-four hour PM_{2.5} standard at sites sampling on the every day schedule in Charleston and Columbia. The Charleston samplers, CPW and FAA, measured twenty-four hour average concentrations of 44.8µg/m³ and 40.5µg/m³ and downtown Columbia Bates sampler (45-079-0019) measured 36.9µg/m³. Continued elevated concentrations were measured throughout the state by the continuous particulate monitors.

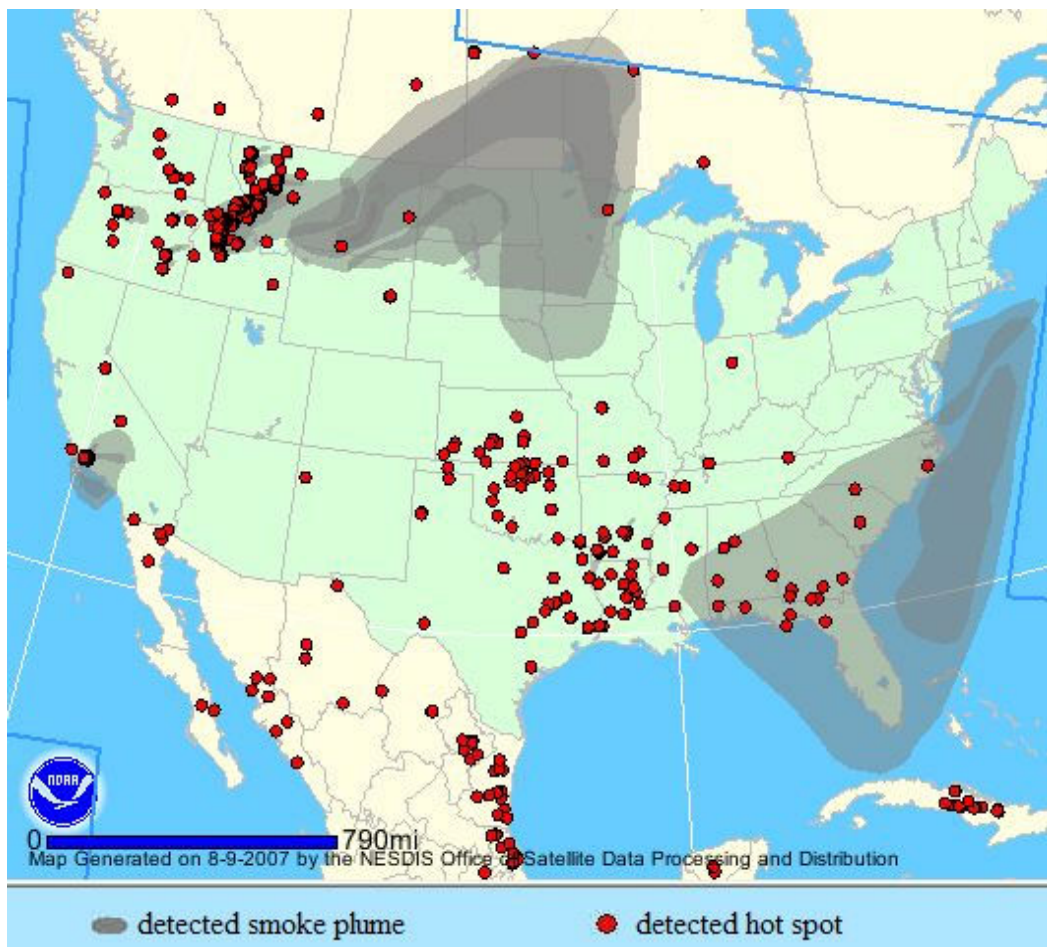
Map 6 indicates lingering smoke across much of the Southeast United States on August 8, 2007. Map 7 shows smoke covering almost all of South Carolina during this same time. Smoke plume transport maps from August 5 through 8, 2007, indicate smoke from the western wildfires was transported eastward and southward into the Southeast United States after which it then lingered for several days.

Wind roses were created to represent the Columbia and Charleston areas (Figures 16 and 17). Wind data from the Charleston National Weather Service Office was used to create a wind rose for the Charleston area. The Columbia area is represented by a wind rose using the wind data from the Columbia National Weather Service Office. Wind roses and back trajectories were created for August 8, 2007, for the Charleston and Columbia areas. The wind rose for the Charleston area (Figure 16) indicates a predominantly south to southwesterly wind that was likely influenced by the sea breeze, while the wind rose for the Columbia area (Figure 17) shows a predominant west-southwesterly wind.

Three ninety-six hour back trajectories from Charleston set at three different levels above the surface (Figure 18) indicate air movement from the west and northwest towards the east and southeast into Coastal South Carolina. In addition, all three trajectories indicate there was some downward mixing of air parcels from the upper-levels into lower layers as the air parcels moved southeastward across the lower Ohio River and Tennessee River Valleys, and finally into the Charleston area. Back trajectories for the Columbia area (Figure 19) show a flow out of the west-northwest at the 500 meter and 1500 meter levels.

The differences between the back trajectories and the surface wind roses, especially for the August 8, 2007 event, are due to a complex long-range transport pattern which took place over a several day period. This pattern, combined with complex Southeastern meteorological conditions resulted in lingering Southeast smoke originating with the western wildfires.

Map 6: Smoke across the Southeast on August 8, 2007



Map 7: Detailed smoke plume across South Carolina on August 8, 2007

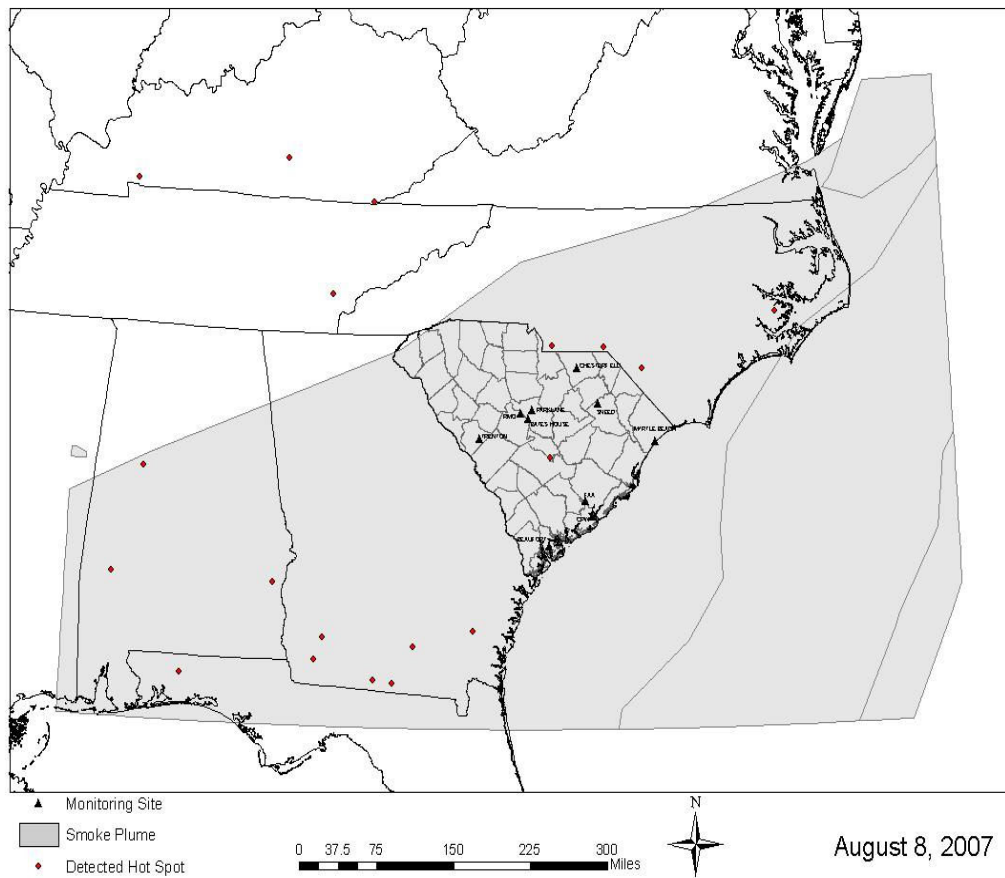


Figure 16: Wind rose from the Charleston National Weather Service Office for August 8, 2007

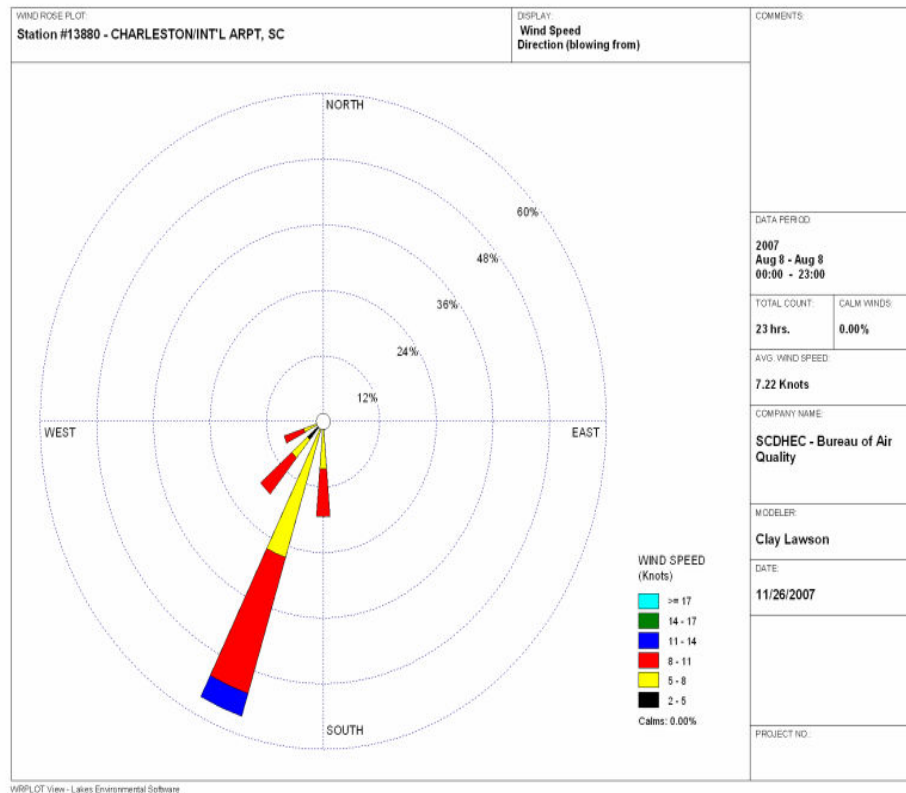


Figure 17: Wind rose from the Columbia National Weather Service Office for August 8, 2007

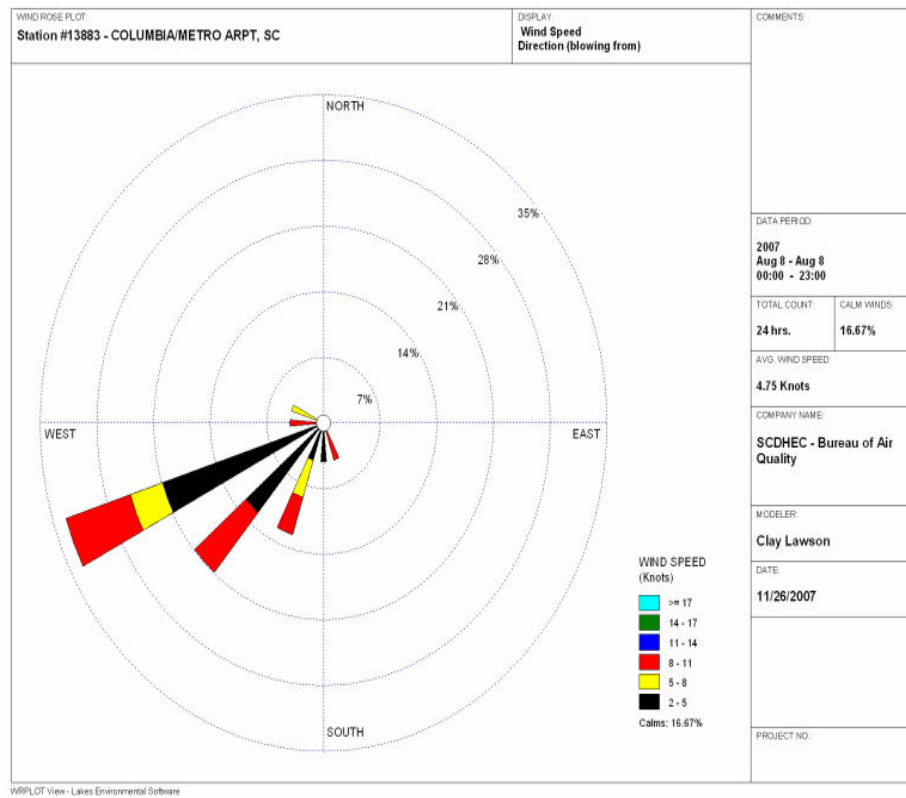


Figure 18: Back trajectories for the Charleston area on August 8, 2007

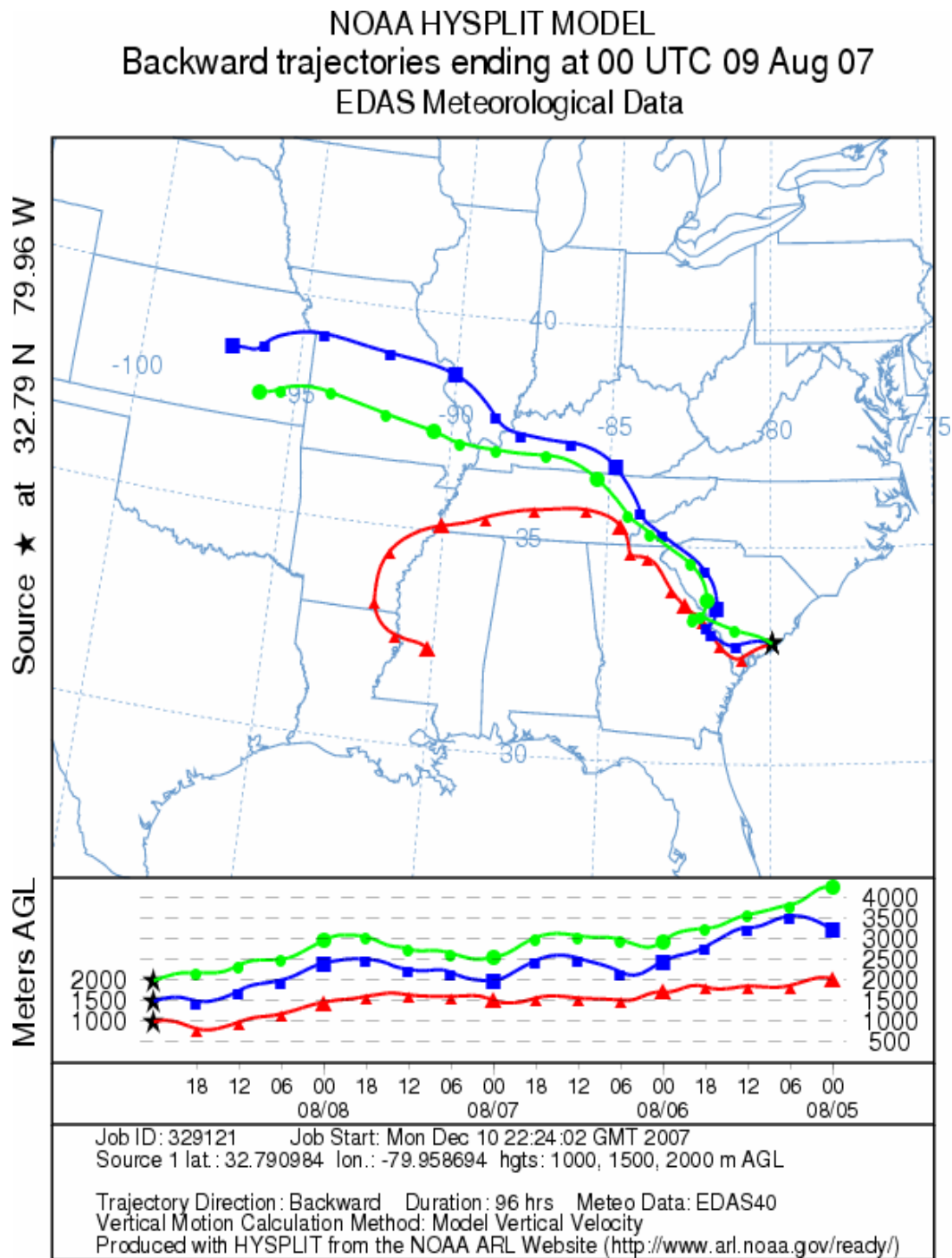
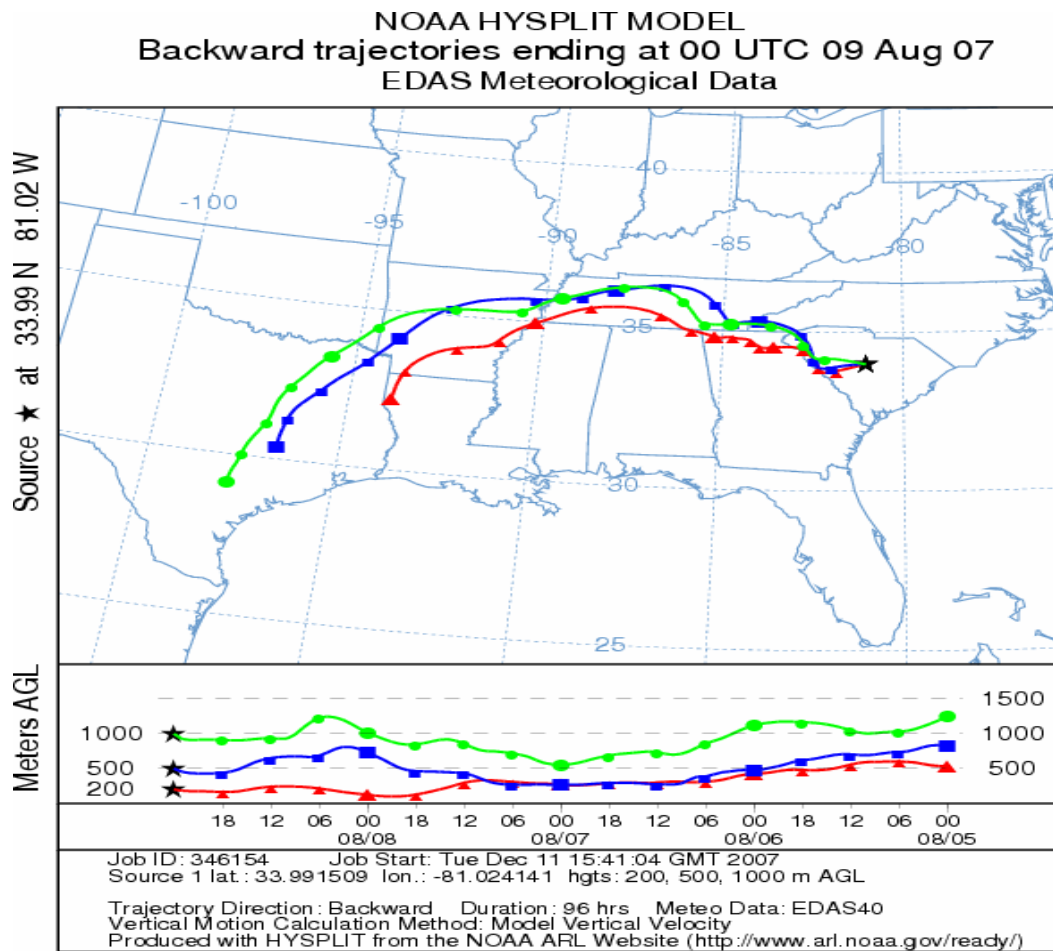


Figure 19: Back trajectories for the Columbia area on August 8, 2007



Event #4D: August 9, 2007 - Columbia area PM_{2.5}

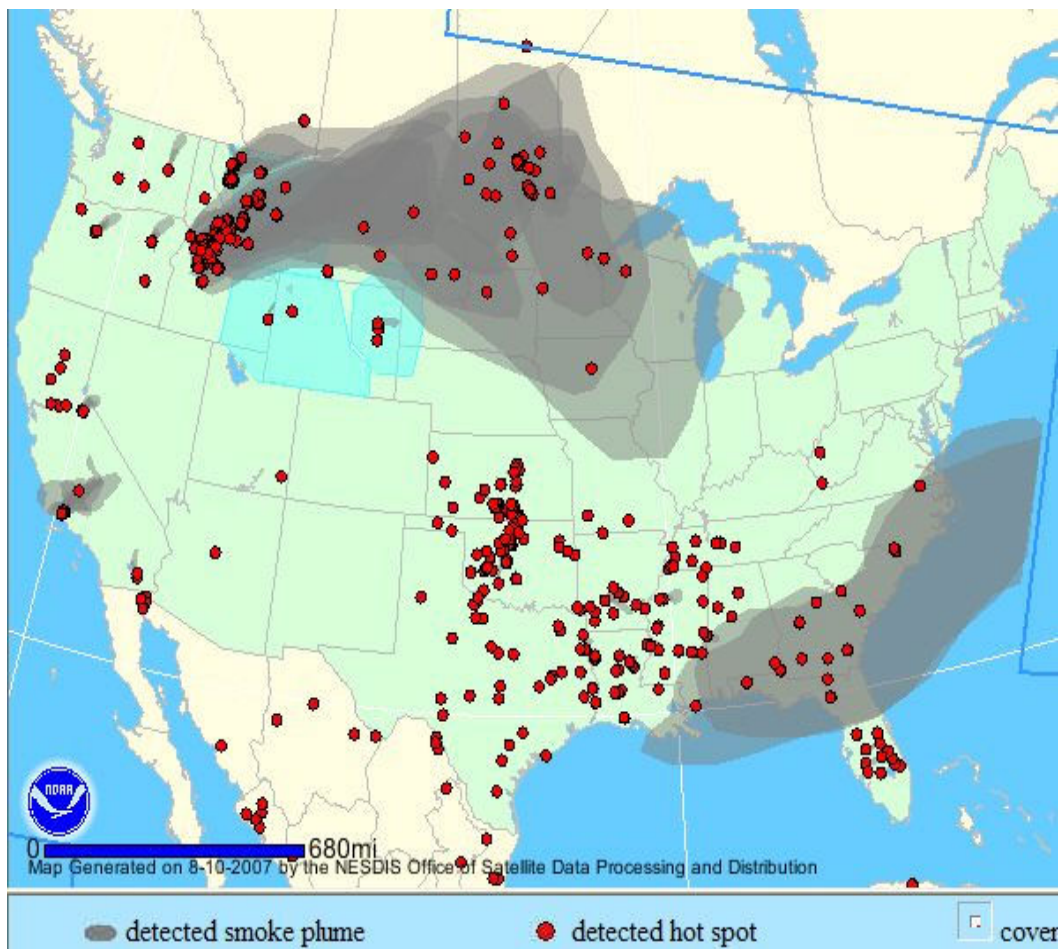
The last two exceedances related to the western fire smoke impacts occurred in the Columbia area at samplers operated on the every day schedule. The downtown Columbia Bates House site concentration was 36.8µg/m³ and the suburban Irmo site concentration was 35.1µg/m³.

Map 8 indicates lingering smoke continued to cover much of the Southeast on August 9, 2007. Map 9 indicates smoke covered the eastern, southern and central portions of South Carolina.

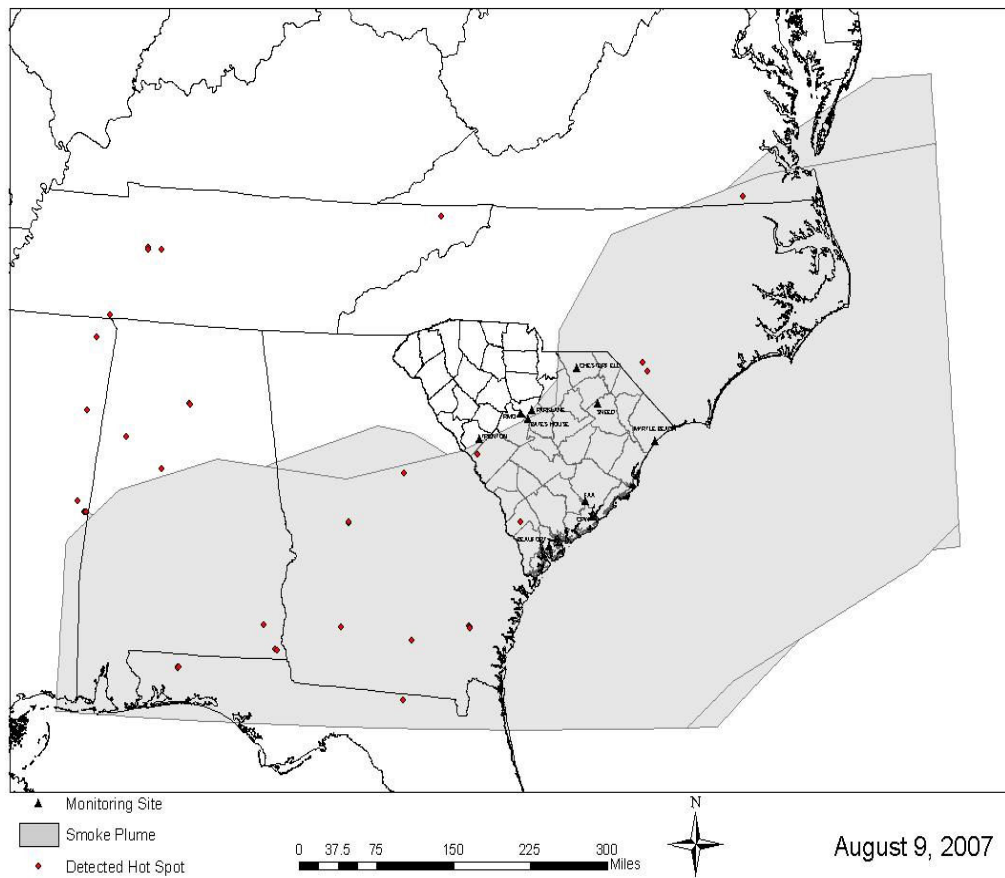
On the same day, the wind rose for the Columbia area (Figure 20) featured a strong southerly component dominating for most of the day. This wind rose also indicates winds were less frequent from the southwest in the Columbia area. The southerly wind flow at the Columbia monitors may have been responsible for transporting smoke northward from the southern sections of the state, where the concentrations of smoke were much higher. The Department believes this smoke was transported northward by this southerly wind direction and impacted PM_{2.5} levels at the Irmo and Bates House sites.

The back trajectories for Columbia (Figure 21) show a different air flow pattern at 500 meters and 1500 meters above the surface. These trajectories show air moving from the Tennessee Valley, east-southeastward into central South Carolina.

Map 8: Smoke across the Southeast on August 9, 2007



Map 9: Detailed smoke plume across South Carolina on August 9, 2007



The AQI map (Map 10), displays elevated hourly $PM_{2.5}$ levels across much of central and eastern South Carolina during the early afternoon hours on August 9, 2007.

Map 10: AQI map showing elevated $PM_{2.5}$ concentrations over much of central and eastern South Carolina on August 9, 2007

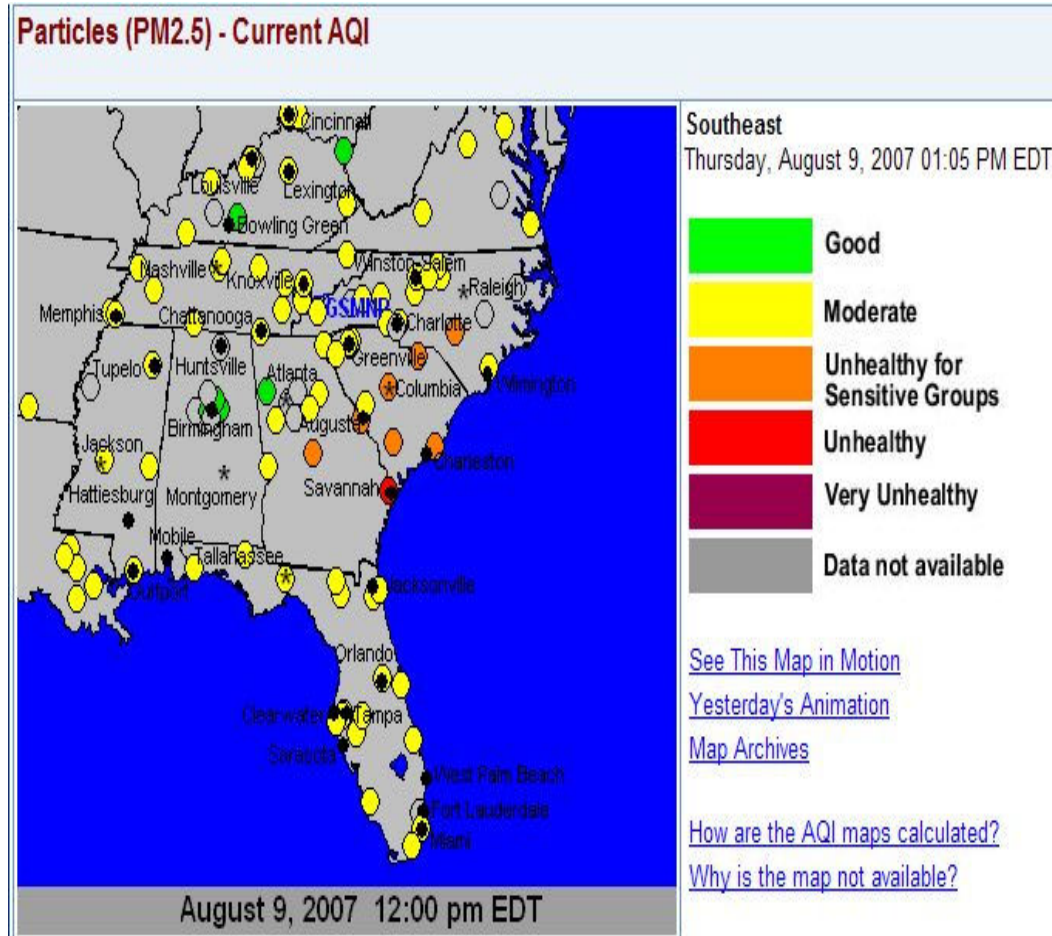


Figure 20: Wind rose for the Columbia area on August 9, 2007

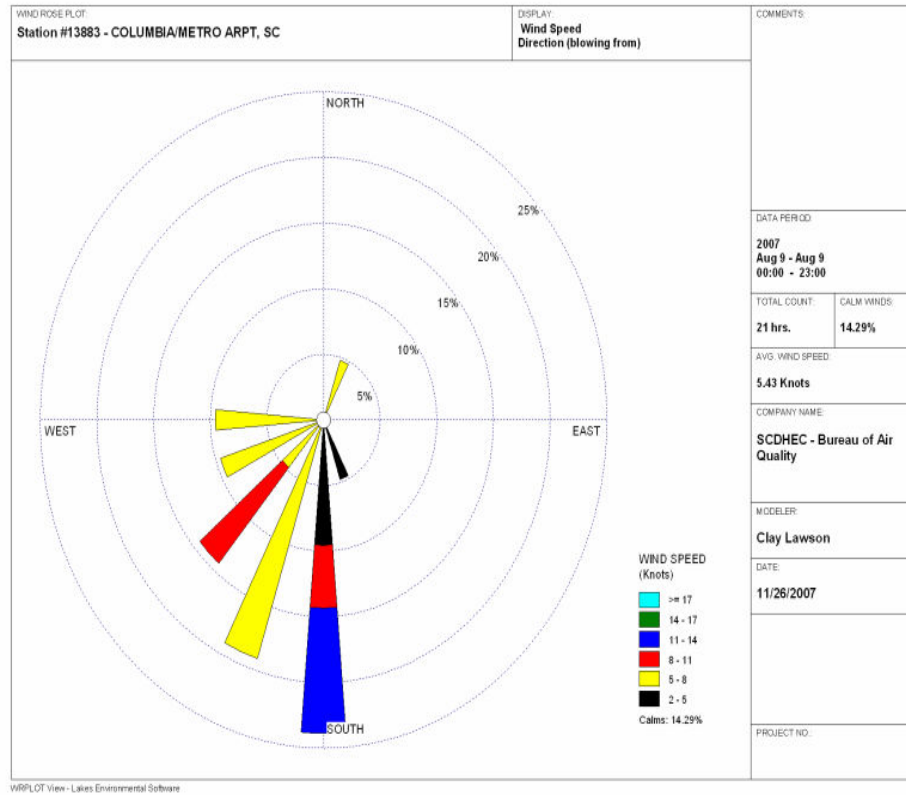
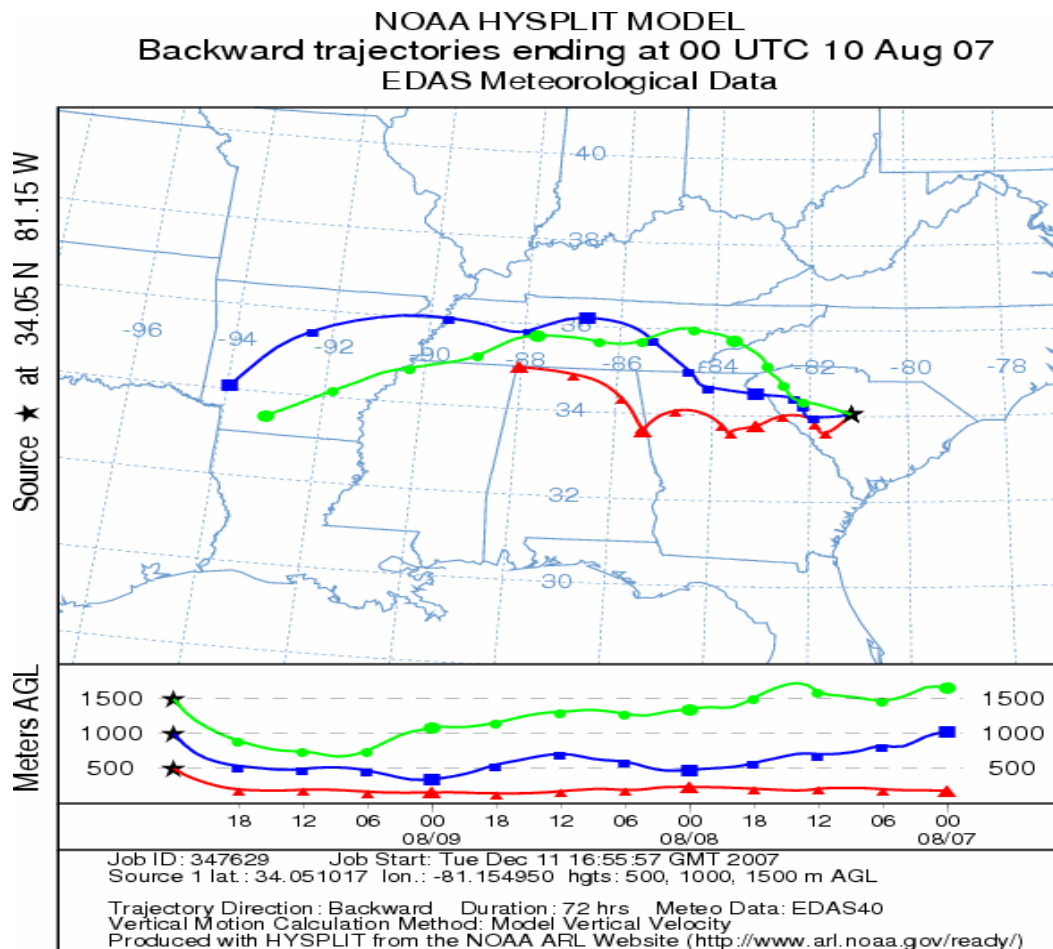


Figure 21: Seventy-two hour back trajectory for the Columbia area on August 9, 2007



Monitoring data for this period show continuing impact of the western fires on South Carolina particulate concentrations from August 4 through 12, 2007. The impacts were greatest and longer lasting from the Midlands (Augusta through Columbia) to the coast. The continuous monitoring and daily samplers recorded a week-long event, with the samplers operating on the 1:3 intermittent sampling schedule capturing concentrations exceeding the twenty-four hour standard at the peak on August 8, 2007.

The Department believes the evidence and analysis indicate a causal link between the Montana and Idaho wildfires and elevated $PM_{2.5}$ concentrations across South Carolina.

Event #5: December 11, 2007 - Myrtle Beach PM_{2.5}

Unusually high concentrations of PM_{2.5} were recorded at the Myrtle Beach PM_{2.5} sampler on December 11, 2007 due to an on site sandblasting operation. The sandblasting of the municipal water tower was required for maintenance and occurred during two regularly scheduled sampling periods. The timing of the observed atypical PM_{2.5} concentration is consistent with the sandblasting activity noted on the sample data sheets. In Figure 22, the area shaded in yellow indicates the relative positions of the tower undergoing maintenance and the sampler. The Department believes these abnormally high PM_{2.5} concentrations are directly related to the sandblasting operation due to the timing and close proximity to the Myrtle Beach sampler.

Figure 23 shows the statewide daily PM_{2.5} concentrations during the period. At no other time has the Myrtle Beach concentrations deviated as dramatically from the concentrations measured throughout the remainder of the state. Sample documentation indicated activities related to the water tower maintenance occurred during the December 8 and December 11, 2007 sample collections. The December 8, 2007 sample has been flagged for data user information but the PM_{2.5} concentration does not appear to have been significantly impacted and concurrence is not requested for that sample value.

For 2007, typical PM_{2.5} concentrations remained well below 35ug/m³. In addition to the sandblasting event, there is only one other exception to the normally low daily PM_{2.5} concentrations. The unusually high concentration period was related to the Western wild fires impact around August 7, 2007 and is described earlier as Event 4B.

The December 11, 2007 average 24 hour PM_{2.5} concentration measured during the water tower maintenance was 44ug/m³. The Department believes that the exceedance of the level of the 24-hour average PM_{2.5} NAAQS was due to the sandblasting that occurred adjacent to the PM_{2.5} sampler.

This event meets the requirements for exclusion as an Exceptional Event in that air quality immediately around the activity (and monitoring site) was impacted, the required maintenance of the municipal water system is required and although the dust was controlled, the proximity of the sampler constrained the measurement to within the job site, the event was caused by human activity, and although maintenance is periodic, the activity is relatively rare (once each 8 to 10 years) and is unlikely to recur.

Figure 22: Sandblasting location next to the PM_{2.5} sampler



Figure 23: PM_{2.5} concentrations showing PM_{2.5} levels during the sandblasting operation.

